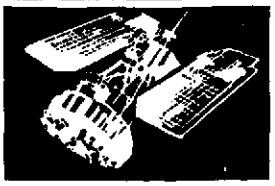
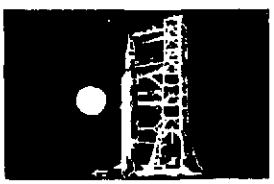
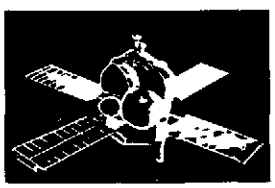
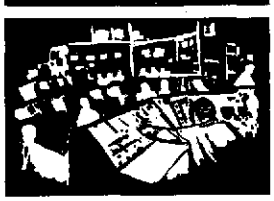
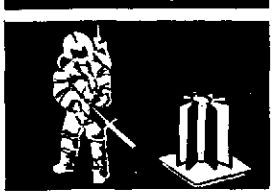
Document No. 74SD4249
16 September 1974

SPACE DIVISION

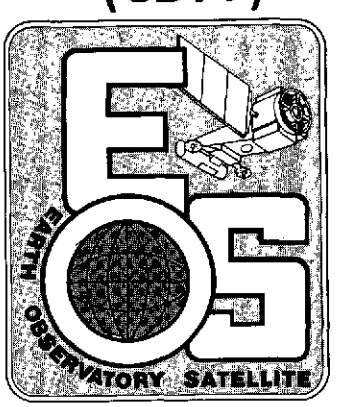






EARTH OBSERVATORY SATELLITE SYSTEM DEFINITION STUDY

Report No. 5
SYSTEM DESIGN AND SPECIFICATIONS

Volume 6
SPECIFICATION FOR EOS CENTRAL DATA PROCESSING FACILITY (CDPF)



Prepared for:
GODDARD SPACE FLIGHT CENTER
Greenbelt, Maryland 20771

Under
Contract No. NAS 5-20518

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GENERAL ELECTRIC

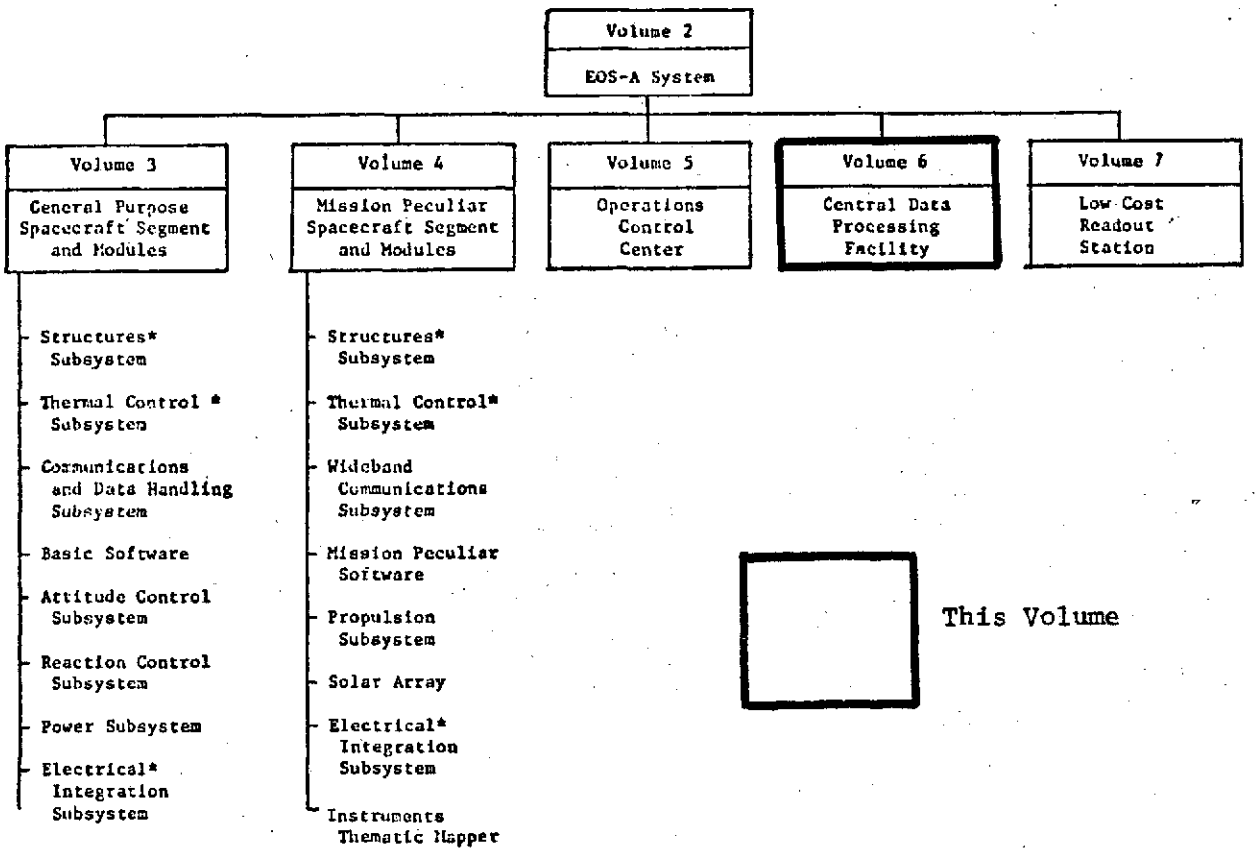
PREFACE

This report, "Baseline System Design & Specifications", has been prepared for NASA/GSFC under contract NAS 5-20518 EOS System Definition Study. It describes the system design that has evolved through a series of design/cost tradeoffs to satisfy a spectrum of mission/system requirements. The basic spacecraft design is compatible with many missions. The EOS-A mission, the potential first mission, is used to define the mission peculiar elements of the system.

For convenience this report is bound in separate volumes as follows:

Volume 1	Baseline System Description
Volume 2	EOS-A System Specification
Volume 3	General Purpose Spacecraft Segment and Module Specifications
Volume 4	Mission Peculiar Spacecraft Segment Specification
Volume 5	Operations Control Center Specification
Volume 6	Central Data Processing Facility Specification
Volume 7	Low Cost Ground Station Specification

Volume 1 "Baseline System Description" presents the overall EOS-A system design, a description of each subsystem for the spacecraft, and the major ground system elements. Volumes 2 through 7 present the specifications for the various elements of the EOS system and are organized according to the specification tree as follows:



* These specifications are written as integral specifications for the GPSS and MPSS and appear in Volume 3 only.

Specification SVS-XXXX
16 September 1974

SPECIFICATION

FOR

EOS

CENTRAL DATA PROCESSING FACILITY

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

SECTION 1

SCOPE

This specification establishes the performance, design, development, and test requirements for the Earth Observation Satellite (EOS) Central Data Processing Facility (CDPF) segment of the GDHS to be located at GSFC in Building TBD .

SECTION 2

APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein. In the event of conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

NASA		
S-323-P-5A		Quality Assurance Requirements for Standard Industrial Equipment
NPC-250-1	April 1969	Reliability Program Provisions for Space System Contractors
NPC-200-3	April 1962	Inspection System Provisions for Suppliers of Space Materials, Parts, Components, and Services
GMI-8040.1	October 1967	Configuration Management
MILITARY		
MIL-STD-470		Maintainability Program Requirements (for System and Equipments)
GENERAL ELECTRIC		
SVS TBD		Specification for the Image Processing Element of the CDPF
SVS TBD		Specification for the Data Management Element of the CDPF
SVS TBD		GDHS/Orbit Determination Group Interface Control Document
SVS TBD		Ground Data Handling System Reliability/ Maintainability Program Plan
SVS TBD		GDHS Grounding Requirements Specification
SVS TBD		GDHS Quality Assurance Program Plan

SECTION 3

REQUIREMENTS

3.1 SYSTEM DEFINITION

3.1.1 GENERAL DESCRIPTION

The Central Data Processing Facility (CDPF) will receive from the Earth Observation Satellite (EOS) sensor data and spacecraft data via the Spaceflight Tracking and Data Network (STDN) and the Operations Control Center (OCC). The CDPF will process this data and produce high density digital tapes (HDDT), computer compatible tapes (CCT), film and paper print images and other data products.

The CDPF will process all EOS sensor data, provide storage for processed data, and provide dissemination service to user agencies.

Data inputs shall consist of:

1. User requirements from the EOS Project Office
2. Orbital data from the NASA Orbit Determination Group (ODG)
3. Weather data from the National Oceanographic and Atmospheric Administration (NOAA)
4. Sensor video tapes from the Spaceflight Tracking and Data Network (STDN)
5. Sensor video tape content from the OCC
6. Spacecraft performance, health and status data from the OCC
7. Data Collection System (DCS) data from the OCC

Data processing shall consist of:

1. Providing geometric and radiometric correction to all sensor data
2. Converting all corrected sensor data to high density digital tapes (HDDT)
3. Converting HDDT's to imagery as required
4. Converting HDDT's to CCT's as required
5. Annotations of imagery alphanumeric data, location code, grey scale,

image quality and cloud assessment

6. Providing extractive processing for selected themes
7. Generation of one band of all imagery from each SEASOP for catalog purposes
8. Establishing and maintaining catalog data base of all processed imagery

Data outputs shall consist of:

1. Imagery data on HDDT'S
2. Imagery data on computer compatible tapes (CCT's)
3. Black and white and color imagery transparencies and paper prints
4. DCS data in form of listings, magnetic tapes and punched cards
5. Catalog data for user assistance
6. Extracted data in form of enhanced imagery and listings

3.1.2 FUNCTIONS

The CDPF shall be capable of performing the following tasks:

1. Serve as the focal point for all image processing
2. Receive wideband video tapes of sensor data
3. Receive selected PCM telemetry data such as spacecraft status and sensor scheduling times from the OCC
4. Provide ground control points to OCC for mission planning and other auxilliary data for transmission to the spacecraft
5. Use the selected telemetry data for annotation of all imagery
6. Geometric and radiometric correction of imagery
7. Convert all wideband video data to HDDT's
8. Based on user requests generate CCT's or hard copy to the highest quality possible
9. Catalog and archive HDDT's and imagery

10. Based on user requests generate extractive processed products and listings
11. Process DCS data
12. Provide user servicing with catalog data and microfilm
13. Provide a Browse facility
14. Provide HDDT's for dissemination to user agencies (e.g., EROS Data Center)

3.1.3 SYSTEM DIAGRAM

Subsystems which shall be provided as part of the CDPF together with related interfaces are shown in Figure 3.1.3-1.

3.1.4 SYSTEM CHARACTERISTICS

3.1.4.1 Data Processing Characteristics

Data to be processed in the CDPF and forwarded to the data users or project personnel and to data archive are:

a) Thematic Mapper (TM) image data
b) High Resolution Pointable Imager (HRPI) image data
c) Data Collection System (DCS) data
d) Custom TM and HRPI image data
e) Standard Catalogs
f) Image Descriptor Indices
g) Microfilm Image Catalog
h) DCS catalogs
i) Extractive processing and Browse File Access
j) User Data Handbook and Support Documentation

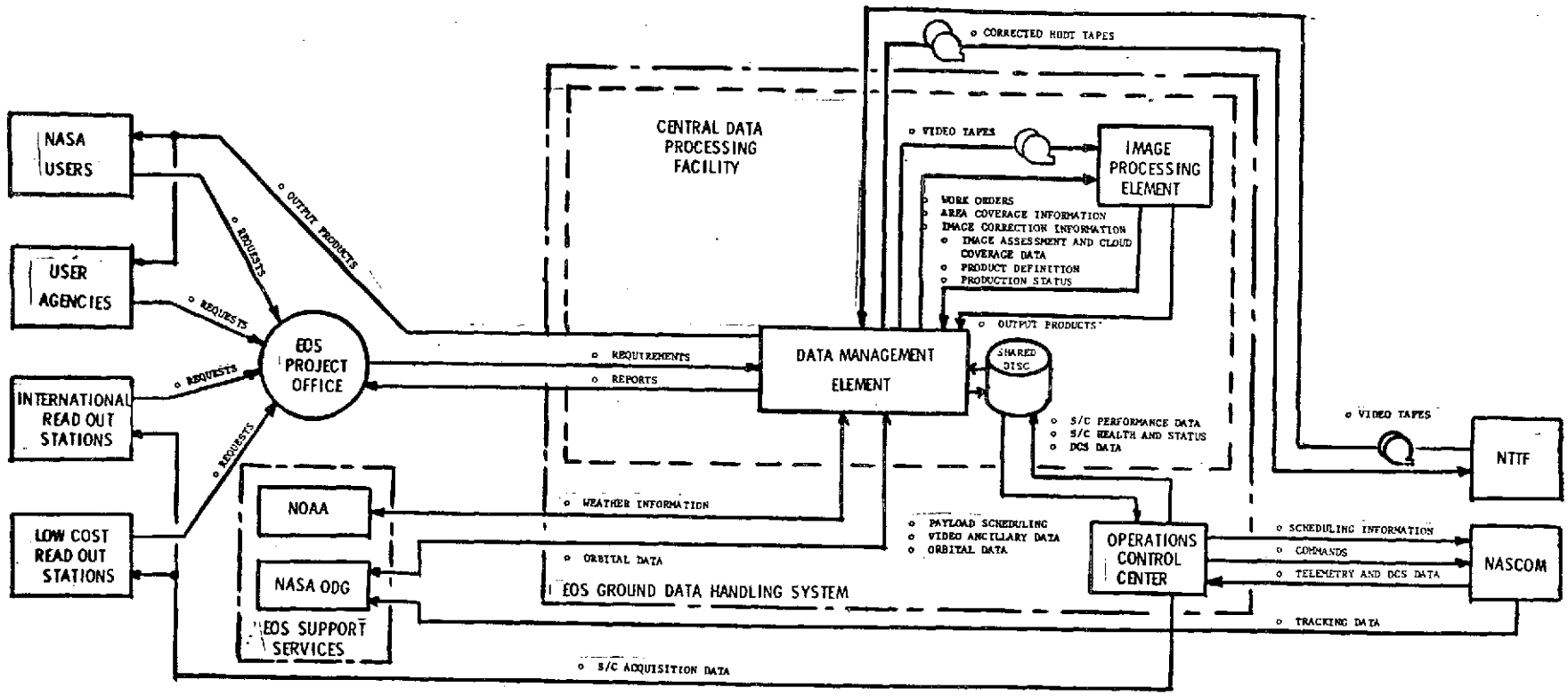


Figure 3.1.3-1. Central Data Processing Facility Subsystems and Interfaces

3.1.4.1.1 Thematic Mapper Image Data

Standard products of Thematic Mapper Imagery shall be High Density Digital Tape (HDDT). Standard HDDT's of U.S. data will be available with radiometric correction applied, and geometric correction using $\frac{\sin x}{x}$ resampling to Space Oblique Mercator(SOM) projection. HDDT's will also be available as a standard with geometric correction data included but not applied (not resampled tapes). Standard HDDT's for non U.S. data will be geometrically corrected to best fit planar projection, using $\frac{\sin x}{x}$ resampling in the along-scan direction only.

Archival products of TM data will be masters of both the resampled and non-resampled HDDT's.

Catalog images of TM data will be 242 mm (9.5 inch) film of the resampled imagery, for one spectral channel. The catalog film image will be at a scale of 1:3,000,000 and images will be framed to correspond to ground coverage of 185 x 185 kilometers (100 x 100 nautical miles). Catalog film images shall have the same characteristics as film images generated as custom products per user request.

3.1.4.1.2 High Resolution Pointable Image Data

Standard HDDT's of U.S. data will be available with radiometric correction applied and geometric correction using $\frac{\sin x}{x}$ resampling to Space Oblique Mercator (SOM) projection. HDDT's will also be available as standard with geometric correction data included but not applied (not resampled tapes). Standard HDDT's for non U.S. data will be geometrically corrected to best fit Planar projection, using $\frac{\sin x}{x}$ resampling in the along-scan direction only.

Archival products of HRPI data will be masters of both the resampled and non-resampled HDDT's.

Catalog images of HRPI data will be 242 mm (9.5 inches) film of the resampled

imagery, for one spectral channel. The catalog film image will be at a scale of 1:1,000,000 and images will be framed to correspond to ground coverage of 45 x 185 kilometers (25 x 100 nautical miles). Catalog film images shall have the same characteristics as film images generated as custom products per user request.

3.1.4.1.3 Data Collection System Data

Data Collection System data shall be processed as to its source, time and quality, and will be provided to users in the form of computer cards, listings or magnetic tape.

3.1.4.1.4 Custom Thematic Mapper and High Resolution Pointable Imager Data

Upon request from users, selected TM and HRPI data will be custom processed to provide the data products shown in Table 3.1.4-1.

3.1.4.1.5 Standard Catalogs

Standard Catalogs announcing available EOS images shall be produced and sent to users every 17 days. Separate catalogs shall be provided for U.S. and Non-U.S. coverage, each containing data from full 17-day cycles and consisting of an introduction, an outline map graphically displaying coverage, and a computer tabulation listing by observation number the imagery obtained in sequential order. Catalogs shall be issued within two (2) weeks after the end of the 17 day cycle.

3.1.4.1.6 Image Descriptor Index

A cumulative catalog of image descriptors shall be produced every 30 days and distributed to the users. The index will be generated from a standard list of image descriptors and those supplied by individual investigators based on their analyses.

Table 3.1.4-1. Custom TM and HRPI Products

Custom Product	Characteristics
High Density Digital Tape (HDDT)	1. Direct copy of archival HDDT 2. Copy of archival HDDT with custom resampling - Nearest neighbor - Bilinear curve fit 3. Copy of archival HDDT with - Pixel reformatting - Resolution reduction - MTF compensation - Digital enlargement
Computer Compatible Tape (CCT)	1. Copy of archival HDDT 2. Copy of archival HDDT with custom resampling - Nearest neighbor - Bilinear curve fit 3. Copy of archival HDDT with - Custom projection to Universal Transverse Mercator (UTM) - Pixel reformatting - Resolution reduction - MTF compensation - Digital enlargement
Film Images and Prints	

3.1.4.1.7 Microfilm Image Catalog

Microfilm images shall be made of one band of imagery for each EOS sensor. These shall be published in U.S. and Non-U.S. catalogs in 17 day cycles. The images will allow screening of data by users and shall be organized in a manner permitting rapid correlation with the Standard Catalog. Catalogs shall be issued within two (2) weeks after the end of each 17 day cycle.

3.1.4.1.8 DCS Catalog

Every 30 days a catalog shall be published and delivered to DCS data users summarizing number of transmission, collected by identification, location, transmission times and number of messages. The catalog shall be issued TBD.

3.1.4.1.9 Extractive Processing and Browse File Access

Terminal access will be provided to EOS users for extractive processing. Terminals will be available in the Browse area for the users and assistance will be provided to describe processing techniques available at the facility. Customer algorithms will be evaluated for incorporation into the extractive processing library if justified. A handbook will be prepared and maintained describing user instructions and available techniques.

3.1.4.1.10 User Data Handbook and Support Documentation

Data availability shall be disseminated to the User Community by means of documentation prepared by the CDPF. These data shall include the technical details consisting of handbooks, brochures, drawings, and other technical data that is explanatory to the EOS system and specifically required by the EOS users in order to conduct a complete and significant investigation with the specified products. These complementary and supplementary technical data items shall be self-explanatory and not require reference and access to the bulk documentation that is required in the system design, development, fabrication, assembly, test and operation activities.

3.1.4.2 Delivery Times

a. The CDPF will produce image data for dissemination agencies and other standing orders within TBD days from receipt of video tapes.

b. User data requests for extracted data will be provided as rapidly as possible.

c. User data requests for catalog data will be processed within TBD days of request.

3.1.4.3 CDPF Pollution Abatement

The design and installation of a pollution abatement system which will permit photographic wastes from the CDPF to be released into the local sewage system shall be incorporated into the facility.

Pollution abatement is to be accomplished mainly by reduction of pollutants in waste by either recycling and/or removal of pollutant from waste.

3.1.4.3.1 Silver Recovery

Silver recovery procedures, techniques, and controls shall be incorporated into the facility.

3.1.4.3.1.1 Silver Recovery from Fixers. A silver recovery system for removing approximately 97% of the silver from the fixing baths shall be incorporated into the facility. The silver recovery system shall recycle the fixing solution before disposal when economically feasible.

3.1.4.3.1.2 Silver Recovery from Photographic Wastes. A silver recovery system

or procedure for removal of silver from photographic waste materials shall be incorporated into the facility.

3.1.4.3.2 Bleach Recycling

Capability for rejuvenating and recycling the bleach solutions for reuse shall be incorporated into the facility.

3.1.4.4 Electrical Power Requirements

Electrical power required by the CDPF shall be nominally TBD

3.1.4.5 Air Conditioning Requirements

Air conditioning required by the CDPF shall be nominally TBD

3.2 SUBSYSTEM PERFORMANCE CHARACTERISTICS

3.2.1 IMAGE PROCESSING ELEMENT (IPE)

Specifications for the IPE will establish:

- o Interface Definition
- o System Radiometric accuracy
- o System geometric accuracy
- o Throughput capability

each of the major subsystem elements as required. In addition, although the existing ERTS photographic processing facility is to be used for film processing, all film process control and chemistry will be specified for the particular film type to be used in the Laser Beam Image Recorder (LBIR).

It is assumed that software packages for individual Subsystems of the IPE contain all processing instructions and that the DME only provides control and initialization parameters.

3.2.1.1 Online Image Processing

3.2.1.1.1 General Requirements

a) The system will operate on a two pass basis, with quality evaluation and correction data stripping performed on the first pass and actual corrections applied on the second pass

b) Correction functions will be computed during tape rewind between the first and second pass and stored on a disk memory for use in the second pass

c) Not-resampled tapes may be re-input on a third pass for custom resampling algorithms to be applied

d) Standard resampling will be $\frac{\sin x}{x}$

e) Custom resampling will be either nearest neighbor or bilinear curve fit

f) Standard projection used for geometric correction will be Space Oblique Mercator (SOM) for U.S. data, and best fit planar for non-U.S. data

g) Processing will be performed at real time rates for the first pass, and at TBD % of real time for the second pass

h) The system will be capable of processing 175 scenes/day through both passes for both the HRPI and TM sensors, out of a total of 230 scenes/day input to first pass.

i) The Bit Error Rate will be less than TBD

3.2.1.1.2 Interface Requirements

a) All sensor data will be input on HDDT

b) Standard output products will be resampled and not-resampled HDDT's, generated simultaneously , together with catalog and quality assessment data

c) Custom output products will be a custom resampled HDDT only

d) Standard output products will be cataloged and placed into the CDPF archive facility

e) All work orders and control instructions will originate from the DME,

and will be input directly without operator intervention

f) Operator override capability will be provided over DME generated control and input data

g) Catalog and quality assessment data will be output as hard-copy records as well as being returned to DME to be included in the CDPF data base

3.2.1.1.3 Geometric Accuracy

a) Residual geometric errors after correction for line length, earth rotation, earth curvature and sensor scan angle effects shall not exceed
450 meters RMS after x correction using predicted ephemeris, and
170 meters RMS after x correction using Best Fit Ephemeris

b) Residual geometric errors after an x, y correction using Ground Control Point correlation shall not exceed 15 meters RMS

3.2.1.1.4 Radiometric Accuracy

a) Residual banding shall be less than TBD % of full scale after radiometric corrections are applied

b) The radiance of each pixel of the resampled image shall be accurate to within TBD % of the value which would have been observed were it a not-resampled pixel

3.2.1.2 Tape-to-Tape Copying Subsystem

3.2.1.2.1 General Requirements

a) The system will copy resampled and not-resampled HDDT's

b) Special processing in the HDDT-to-HDDT copy subsystem will provide for:

- o Pixel reformatting
- o resolution reduction
- o MTF compensation
- o Digital enlargement

c) Special processing in the HDDT-to-CCT copy subsystem will provide for:

- o Pixel reformating
- o Resolution reduction
- o MTF compensation
- o Digital enlargement
- o Custom map projection to Universal Transverse Mercator (UTM)

d) The HDDT-to-HDDT copy subsystem will have the capacity to generate up to 10 copies of 40 U.S. scenes and 4 copies of 135 Non-U.S. scenes per day, for a total output of 940 copies per day.

e) The HDDT-to-CCT copy subsystem will have the capacity to copy up to 35 scenes/sensor/day with one copy per scene generated

f) The tape copies generated will be disseminated directly to the user

g) The Bit Error Rate will be less than TBD

3.2.1.2.2 Interface Requirements

a) Data input may be either resampled or not-resampled HDDT's

b) The system will provide a capability to generate HDDT copies of previously generated CCT's

c) Data output will be either HDDT or CCT

d) All work orders and control instructions will originate from the DME, and will be input directly without operator intervention

e) Operator override will be provided over DME generated control and input data

f) System status, diagnostics and requests for operator intervention will be output to hard copy printer

g) Control instructions and parameter initialization will be requested from the DME

3.2.1.2.3 Radiometric Accuracy

Not applicable

3.2.1.2.4 Geometric Accuracy

a) Data conversion to custom projections will be performed with an accuracy of TBD

3.2.1.3 Film Image Generation Subsystem

3.2.1.3.1 General Requirements

a) Catalog film generation of archival HDDT data will be the highest priority activity for the Film Image generation subsystem

b) Intermediate HDDT's will be generated on a preprocessing system for input to the Laser Beam Image recorders

c) Intermediate HDDT's will contain all data required to generate a complete film image:

- o Image data including overlap where required
- o Annotation information
- o Digital data required to generate a TBD step gray scale, with steps of TBD
- o Blank records to allow image frame separation on the film roll

d) Intermediate HDDT's will be formulated on an image-by-image basis

e) Film type used in the LBIR will be TBD

f) Exposed film from the LBIR will be processed by the existing ERTS photo processing facility using TBD chemistry to a gamma of TBD

g) Throughput of the Film Image Generation subsystem will provide 175 scenes/sensor/day of catalog film plus an additional 60 scenes/sensor/day of custom imagery

h) The LBIR will use standard 9.5" wide film, loaded on TBD foot rolls

3.2.1.3.2 Interface Requirements

a) Inputs to the Film Image generation subsystem will be resampled or not-resampled HDDT's custom HDDT copies, or custom CCT's

b) All work orders and control instructions will originate from the DME and will be input directly without operator intervention

c) Operator override will be provided over DME generated control and input data

d) System status, diagnostics and requests for operator invervention will be output to a hard copy printer

e) Photographic processing work orders will be generated on the hard copy printer

f) The DME will generate specific notices to release intermediate film image HDDT's for degaussing and refurbishment for reuse

g) Data output will be exposed film ready for processing by the photo processing facility

3.2.1.3.3 Radiometric Accuracy

a) Spot intensity will be within TBD % of the value required to expose the film to the desired density

b) LBIR spot intensity stability will be TBD

c) When used in a linear intensity mode, the LBIR spot intensity will be linear within TBD % relative to input digital word values

d) When used with premphasis nonlinear gain, the LBIR spot intensity will be within TBD % of the desired value

e) LBIR spot intensity will rise from 10% to 90% of full intensity in the time the sweep moves TBD % of one pixel

f) The LBIR spot diameter will be less than TBD measured at the TBD intensity points

g) The LBIR spot intensity shall be less than TBD % of maximum at TBD radius from the spot center

3.2.1.3.4 Geometric Accuracy

a) The LBIR spot sweep across the film shall be linear to TBD

b) The film transport will position the film to within TBD from sweep to sweep

c) The film will be positioned so that its maximum displacement from the platen is TBD

3.2.1.4 Extractive Processing/Browse File Access

3.2.1.4.1 General Requirements

a) Browse file terminals will permit review of narrative catalog data and imagery from archival HDDT's only

b) Extractive processing terminals will permit user interaction with imagery data to perform:

- o Coordinate transformation
- o Classification
- o Image Comparison
- o Image rationing
- o Combination of channels via linear transformation

c) Image data will be loaded onto a refresh disc so that image displayed may be changed within TBD seconds

d) Display terminals will provide three color (red, green, blue) capability with a capability to direct data from any spectral band to any color

e) The extractive processing system will operate as a stand alone system

3.2.1.4.2 Interface Requirements

a) Image data will be input from resampled or not-resampled HDDT

b) Browse file access terminals will interrogate the CDPF data base narrative catalog on demand as required

c) Output products from the extractive processor will be hard copy color printer output, line printer output and CCT's of processed image data

d) Output CCT's will be available in a format compatible with the Film Image Generation System if required

e) User interaction with the extractive processing and browse file access subsystem will be through light pen and keyboard instruction at the display terminal

f) HDDT's required for access will be available from the archive within TBD of a request

g) HDDT's will be available for mounting on the extractive processing/ browse file access system only after specific release by DME for that purpose

3.2.4.1.3 Radiometric Accuracy

Not Applicable

3.2.4.1.4 Geometric Accuracy

Not Applicable

3.2.1.5 Archive Facility

3.2.1.5.1 General Requirements

a) The archive facility will provide for storage of resampled and not-resampled HDDT's and originals of catalog film

b) Catalog film original will be retained in the archive for TBD days

c) HDDT storage will be maintained at a temperature of TBD and relative humidity of TBD

3.2.1.5.2 Interface Requirements

a) Storage location for HDDT and film image products will be specified by DME

b) HDDT and film image products will be removed from the archive only on specific DME instruction

c) Access to archive storage files will be limited to archive librarian personnel only.

3.2.1.5.3 Radiometric Accuracy

Not Applicable

3.2.1.5.4 Geometric Accuracy

Not Applicable

3.2.2 DATA MANAGEMENT ELEMENT (DME)

Specifications for the DME will establish:

- o Interface Definition;
- o User Request Processing Capability;
- o Production Control Capacity:
- o IPE Direction and Control.

The DME shall be composed of subscriptions:

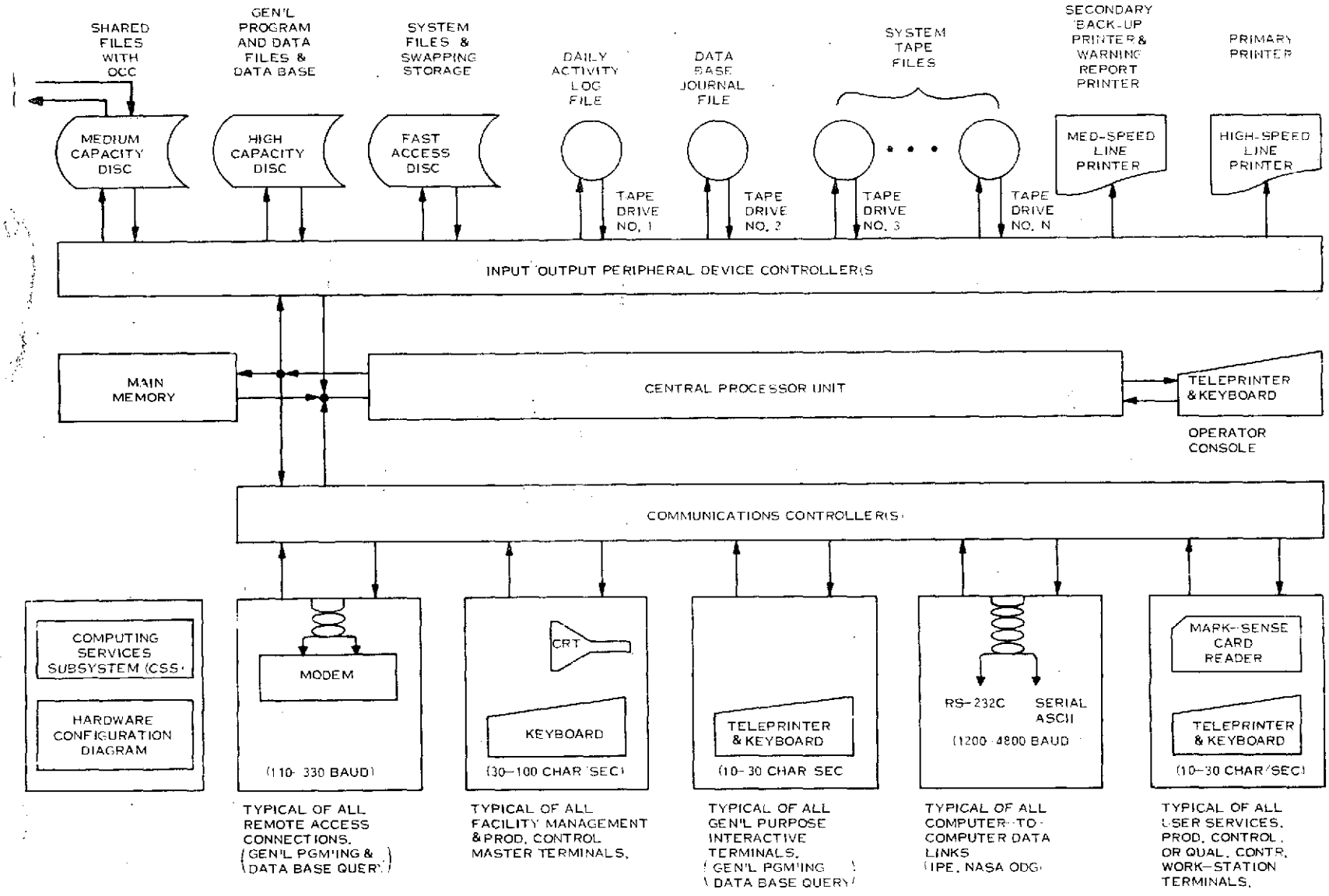
- o Computing Services Subsystem (CSS)
- o Support Services Subsystem (SSS)

3.2.2.1 Computing Services Subsystem (CSS)

The CSS shall provide the hardware and software to implement the automated functions of the DME.

3.2.2.1.1 CSS Hardware

A hardware block diagram of the CSS is shown in Figure 3.2.2-1. The hardware shall provide the environment for the software computer programs to execute, input/output peripheral devices for interface and memory for program and data storage.



- Central Processor Unit - The basic intelligence of the subsystem, executes stored program, manipulates data and communicates with input/output devices;
- Main Memory - High-speed, random-access memory for on-line storage of programs and data;
- Medium Capacity Disc - Random-access mass storage for storage of data files to be shared with OCC processor;
- High Capacity Disc - Random-access mass storage for storage on Integrated Product-Image Data Base (IPID) and other data files. Also used for storage of program not currently executing;
- Fast Access Disc - Random-access mass storage characterized by minimum latency and high data transfer rate. Used for system software storage and data "swapping";
- Tape Drives - Sequential-access mass storage on removeable magnetic tape reels. One drive dedicated to the Daily Activity Log file - DLOG. One other drive dedicated to the Data Base Journalization file for data base recovery. Other tape drives are used as required for system functions such as read-in of system software, intermediate "scratch" data files and data base "dumps";
- Primary Line Printer - High-speed line printer for all hard-copy reports except those specifically designated for other printers;
- Secondary Line Printer - Medium-speed line printer used for exception (anomalous condition) reporting to Facility Management and Production Control. Also serves as back-up to primary line printer;
- Input/Output Peripheral Device Controllers - Special-purpose hardware interface between Central Processor Unit and the various input-output devices. Primarily used for high-speed parallel data transfer;

- o Communications Controller - Special-purpose hardware interface between Central Processor Unit and various remote terminals. Primarily used for low-medium speed serial data transfer;
- o MODEM - Convert low-speed serial data to audio tones to communicate data over leased or switched telephone lines. At remote locations another MODEM interfaces with a data terminal. The remote terminal may be used for general programming and/or data base query;
- o CRT/KEYBOARD - Medium-speed data terminal for interactive alphanumeric data transmission. Typical of all terminals used by Production Control and Facility Management for System Monitoring and control;
- o TELEPRINTER/KEYBOARD - Low-speed data terminal for interactive alphanumeric data transmission requiring hard copy. These terminals will be those for Data Base Query in the Browse Processing area. Other such terminals may be used throughout the facility for general programming;
- o HIGH-SPEED SERIAL DATA LINKS - These links will operate at high data rates over dedicated lines. Used for all computer-computer data transfer such as between the DSE and the IPE or NASA ODG;
- o TELEPRINTER/KEYBOARD AND MARK-SENSE CARD READER - This special-purpose data terminal shall be used throughout the IPE and DME to implement the Production Control schedule. The low-speed teleprinter-keyboard shall be used to print Manual Work-Orders on special WORK-ORDER forms. The same type of terminal shall be used within the User Services area. All requests for IMAGE PRODUCTS which are not received in computer-compatible format shall be entered by mark-sense card form.

3.2.2.1.2 CSS Software

The CSS software shall consist of two major software subsystems, the Operating System/Data Base Management software and the DME Applications software.

3.2.2.1.2.1 Operating System/Data Base Management. These software modules will provide the basic software environment for the DME applications software. The Operating System shall provide I/O services, language processors, utility services and control of hardware/software system resources. It shall support simultaneous Local Batch, Time-Sharing and Real-Time operations with Transaction Processing Capability. The Operating System shall be provided by the central processor vendor.

The Data Base Management software shall provide a Data Definition Language (DDL) and a Data Manipulation Language (DML) with suitable processors for creating, maintaining, recovery, journalization, retrieval, update, protection and reporting of large multi-structured Data Bases. The DDL and DML shall be consistent with the recommendations of the CODASYL Data Base Task Group Report. The Data Base Management Software modules shall be provided by the central processor vendor and shall operate within the environment of the Operating System software.

3.2.2.1.2.2 DME Applications Software. There shall be 14 major software subsystems. Each subsystem shall be composed of one or more software modules which may be programs, subprograms, procedures and/or overlay segments. In general, the software modules shall execute in the environment of the Operating System software. Software modules may also utilize the Data Base Management System software. Software subsystems shall interface among themselves by mass storage or main memory files. These files may be unique to one or more subsystems or common to all, as the IPID data base files.

3.2.2.1.2.2.1 Priority Pre-Processor Program (P**4). P**4 shall examine all requests for products of images and produce either image or product commands by examining the various request files (standing request file-SRQ, pending request file-PRQ and current request file CRQ) for user requests for products of images. P**4 shall form a single file of valid requests-VRQ ordered by priority. Each

request shall be scanned and compared against the images in IPID. If a suitable image already exists a command entry shall be made in the product command file PCMD to create the requested product. If a suitable image does not exist a command entry shall be made in the imaging command file ICMD to obtain the requested image. Subsequent requests for the same image shall not cause duplicate image commands.

3.2.2.1.2.2.2 Payload Scheduling Software (PSS). PSS shall accept imaging commands and produce data files for the OCC by which the OCC commands the spacecraft operations. PSS shall scan the prioritized file of image commands on the ICMD file and compare against the expected orbital position of the spacecraft (as defined on the predicted ephemeris file EPHM from NASA ODG) and the expected weather and cloud conditions as defined by NOAA (on the weather prediction file WTHR). The program shall attempt to schedule all images which are predicted to be possible, conflicts shall be resolved by the priority of the command.

A feasible time-profile of sensor operations shall be produced on the sensor scheduling SSKD file for the next spacecraft pass.

3.2.2.1.2.2.3 Work Order Generation Program (WOG). WOG shall accept a prioritized list of product commands and, based on standard procedures for standard products, shall produce a set of work/orders.

WOG shall accept product commands from the PCMD file and for each product mand shall produce one or more work-orders. These work-orders shall be based upon a predefined procedure from the standard procedure file STDP for each standard product. Each work-order will be associated with a single type of work-station and each will be tagged as required for proper sequence of execution.

3.2.2.1.2.2.4 Initial Work Order Scheduling Program (IWOS). IWOS shall accept standard work-orders from the Work Order Generation Program or non-standard work-orders from the Production Control Interface Programs and shall merge them into the work-order queue of the appropriate work-station. Relative position within the queue shall be determined by the assigned priority.

3.2.2.1.2.2.5 Work Order Scheduling Program (WOS). WOS shall receive notifications from work stations that they are able to accept work-orders. The notification may be the completion of a previous work-order on the simple fact of availability. WOS shall transmit one or more work-orders to the work-station together with necessary and sufficient information to perform the required operation. The algorithm used to select the work-order to be transmitted shall choose the highest priority feasible work-order in the work-order queue for that work-station.

After choosing the highest priority feasible work-order, the algorithm shall scan the entire work-order queue of that work-station for any other feasible work-orders which could logically be performed at the same time. All work-order data shall be contained in the IPID.

3.2.2.1.2.2.6 Work Order Rescheduling Program (WOR). WOR shall be used to readjust work-orders from the work-station queue originally assigned, to possible alternative work-stations. Thiis program shall always be initiated explicitly by Production Control personnel.

WOR shall reassign work-orders based on predefined procedures as defined in the alternative procedure file ALTP. WOR shall be the only program which may remove a work-order from one work-station queue and place it in another.

3.2.2.1.2.2.7 Production Control Interface Software (PCI). PCI shall be composed of a series of interactive utility programs for selective and exact central of the DME. PCI shall perform five basic utility functions:

1. Interactive Data Base Query and Modification. Selective retrieval and alteration of any item in IPID;
2. Standard Procedure Definition. Interactive definition of a new standard product by defining the sequence of work-orders necessary to generate it. New Procedures are incorporated into the standard procedure file-STDP;
3. Special Work Order Definition. Selective incorporation of non-standard or other special work-orders into special work-order file SWO and into normal production processing;
4. Equipment Status Notification. Interactive update of equipment status file EQST and possible command to execute the work-order rescheduling program to respond to new equipment state;
5. Alternate Procedure Definition. Interactive definition of alternative procedures to be applied under abnormal operating conditions such as equipment failure or abnormally long queues for certain work stations. New definitions update the alternate procedures file ALTP for use by the Work Order Rescheduling Program WOR.

3.2.2.1.2.2.8 Management Reports Software (MGTR). MGTR shall be composed of several individual management report programs. Each program shall produce a different report. New programs for new reports may be added to the system at any time. The individual reports may be interactive for small amounts of information or bulk printing of routine reports. Reports may also be generated because of anomalous conditions which must be brought to the attention of Facility Management and/or Production Control immediately. Reports shall be directed to either the high-speed printer or a special interactive terminal. All reports, with the possible exception of certain warning reports, shall be generated solely from current IPID information.

3.2.2.1.2.2.9 NASA ODG Interface Program (ODGI). ODGI shall be a special-purpose interface program which shall service the communications interface link between the DME and the ODG computers. Predicted and historical ephemeris data shall be received and used to update the spacecraft ephemeris file-EPHM. As new ephemeris data is received, ODGI shall continually replace earlier data for the same time period.

3.2.2.1.2.2.10 Data Collection System Processing (DCSP). The DCSP program shall access shared disc or tape files of DCS data from the OCC. The DCP data file DCPD will contain raw DCP data. The DCSP program shall sort each DCS message by platform and eliminate garbled transmissions. A catalog update for DCS data shall be generated.

3.2.2.1.2.2.11 Interactive Data Base Query Program (QRY). The QRY program shall service the interactive data base query terminals in the Browse processing area. The QRY program shall allow selective data retrieval from the IPID via the Data Base Management System. As a secondary function, QRY shall allow the user to enter product-image requests into the pending request file-PRQ as a result of a successful data base query.

3.2.2.1.2.2.12 Expected Imagery File Generation Program (XIFG). XIFG shall receive spacecraft and sensor performance data from the spacecraft performance data file-SPDF. Based on the timing data and the pending request data in the IPID, XIFG shall generate a file summarizing the expected video tape contents. The file shall also contain Ground Control Point data.

3.2.2.1.2.2.13 HDDT Production Pass 1 Support Program (HDD1). HDD1 shall support the on-line operations of the IPE by controlling the interface between the DME and IPE during Pass 1. It shall control sending and receiving data regarding the video tape being processed and HDDT being generated.

HDD1 shall be activated by the IPE requesting data on the expected contents of a Video Tape. HDD1 shall retrieve the appropriate Expected Video Tape File-XVTF and transmit the information to the IPE. During Pass 1 the IPE shall send assessment data regarding the actual Video Tape Contents back to the DME. After the Video Tape has completed PASS 1, HDD1 shall organize the data by scene and update the IPID. The expected HDDT format shall be planned based on the current image production requests and their priorities. It shall be described in the HDDT production schedule file HPSF.

3.2.2.1.2.2.14 HDDT Production Pass 2 Support Program (HDD2). HDD2 shall support the on-line operations of the IPE by controlling the interface between the DME and IPE during Pass 2. It shall control the sending and receiving of data regarding the production and annotation of HDDT's.

HDD2 shall combine the most recent spacecraft ephemeris data in the EPHM file with the HDDT image production schedule in the HDDT production schedule file-HPSF. It shall produce the necessary and sufficient information to direct the IPE operations of production and annotation of the HDDT. HDD2 shall control the transmission of the data to the IPE as required. HDD2 shall receive back the production status of the HDDT(s).

3.2.2.2 Support Services Subsystem (SSS)

The SSS shall provide the personnel and facilities to implement the manual operations of the DME. The SSS shall direct the operations of the CSS and shall be capable of manual over-ride of any automated function. The SSS shall be composed of the User Services Group and the Production Control Group.

3.2.2.2.1 User Services Group

The User Services Group shall accept request for products of images from users. A user request may be either a standing request or a current request. The former

shall remain in the system regardless of how many times it is satisfied, while the latter shall be purged once it has been satisfied. Requests shall be transmitted from user services to the computer by a mark-sense card reader in the USER services area. The forms shall be filled out by user services personnel by marking specified boxes in pencil in response to a personal visit or a telephone or mail request.

Final products shall be delivered to the user services area. They shall be sorted by user and placed in the destination area for that particular user by user services personnel. Depending upon procedures instituted by Facility Management, products shall either remain in each destination area for pick-up or be periodically collected and mailed to the user by user services personnel.

3.2.2.2.2 Production Control Group

The Production Control Group shall be the direct representative of Facility Management and shall direct and control all phases of the DME.

By direction of Facility Management, the Production Control personnel shall take any and all actions necessary to ensure prompt and accurate response to user requests. Specific Production Control functions shall include:

- Monitoring the status of all equipment, including scheduling of Preventive and Routine Maintenance and timely execution of repairs when necessary, advising the automated Production Control computer programs of equipment status changes;
- Definition to the Automated Production Control computer programs of all allowed primary and alternative procedures for the generation of standard products;
- Definition of specific work-orders to the Automated Production Control computer programs for the creation of special or non-standard products;

- o Monitoring of Production Control computer terminal to be aware and respond to any warnings or anamolous condition reports from the computer

3.2.3 RELIABILITY

MTBF and MTTR factors shall be a consideration in the design and selection of CDPF equipment. A Reliability/Maintainability Program shall be implemented in accordance with selected requirements of NPC 250-1 and MIL-STD-470 as defined in GE Document SVS TBD the R/M Program Plan, which is subject to GSFC approval.

3.2.4 MAINTAINABILITY

CDPF equipment shall be designed to provide accessability and replaceability consistent with requirements for maintenance and servicing, testing, fault isolation and repairing.

3.2.4.1 Service and Access

Sufficient access shall be provided to enable visual and manipulative maintenance servicing and test tasks. Access covers are permitted when required and shall be designed for easy removal.

Where access is obtained via sliding, rotating or hinged units, such units shall be free to open or rotate their full distance and remain in their open position without requiring support by hand. Further, the equipment from which such units are extended to reach their open position shall remain stable (i.e., not subject to tipping over) when said units are extended.

The equipment shall be so designed that it can be easily installed, removed, and re-installed with a minimum of special tools and without extensive disassembly.

3.2.5 USEFUL LIFE

The equipment shall be designed for either two or three shift operation for

5 days per week. Normal maintenance and routine replacement of consumable (known limited life) parts and materials during scheduled maintenance, tune-up and calibration periods shall be permitted.

3.2.6 ENVIRONMENTAL CONDITIONS

Operating and non-operating conditions for the equipment in the CDPF are outlined below.

3.2.6.1 Non-Operating Conditions

a. Equipment - The equipment shall withstand, and subsequently operate, after exposure to the following environment:

Temperature:	+20°F to 100°F
Humidity:	40 to 90%
Vibration and Shock:	As defined in U.S. Govn't Memo, subject "Building 23 Vibration Measurements"

b. Film and Chemicals - All film and processing chemicals shall be stored in the following environment:

Item	Temperature (degrees F)	Relative Humidity (percent)
Black and White and Color Film/Paper		
Short Term (2 weeks or less)	77 max	50 $\pm$ 10
Long Term (greater than 2 weeks)	50 max	50 $\pm$ 10
Sensitometric Strips	32 max	50 $\pm$ 10
Processing Chemicals	77 max	50 $\pm$ 10

3.2.6.2 Operating Conditions

The equipment shall operate to the requirements of this specification during exposure to the environment below:

Temperature:	$72 \pm 2^{\circ}$ F	
Temperature Change:	Δ T 2° F/30 minutes, maximum	
Humidity:	$50 \pm 5\%$	
Humidity Change:	Δ R.H. 2%/30 minutes, maximum	
Shock and Vibration:	As defined in U.S. Government Memorandum, subject "Building 23 Vibration Measurements"	
Cooling:	Plenum Air Temperature	$60 \pm 5^{\circ}$ F
	Blower Outlet Pressure	1.0 ± 0.1 inches of water
	Relative Humidity	$50 \pm 5\%$
	Cooling Flow	TBD CFM

3.2.7 TRANSPORTABILITY

CDPF equipment shall be installed in Building TBD , GSFC. Suitable transportability requirements shall be placed on equipment to assure its safe arrival at Building TBD using commercial transportation and air-ride vans where considered necessary.

3.3 DESIGN AND CONSTRUCTION

The requirements outlined in this section do not apply to equipment identified as commercial "off-the-shelf" equipment. In these cases, S-323-P-5A shall apply.

3.3.1 MATERIALS, PROCESSES, AND PARTS

MS, AN, MIL standard, and commercial materials and parts are acceptable for use

in the CDPF. MIL Standard parts usage is preferred.

3.3.2 ELECTROMAGNETIC RADIATION

Control of electromagnetic interference between CDPF equipment and equipment interfacing with the NDPF shall be effected in an efficient manner. Since much of this equipment consists of commercial Automatic Data Processing (ADP) equipment, or is equipment designed using commercial logic, a formal EMC program including testing to MIL-Standards is not warranted. However, CDPF equipment shall be demonstrated through performance testing to be self compatible at the subsystem or subcontractor level prior to delivery to GSFC for installation and again as a total system at GSFC after installation. EMC problems, if any, uncovered during tests prior to acceptance shall be corrected on an individual basis.

Existance of an EMC problem and determination of its solution adequacy shall be finally determined by a representative specified by NASA.

3.3.3 IDENTIFICATION AND MARKING

All assemblies and subassemblies shall be marked with an identifying number and, if space permits, the manufacturer's identification and component nomenclature. Electrical parts shall be labeled with reference designations in accordance with accepted practices to permit easy identification.

3.3.4 WORKMANSHIP

All CDPF equipment shall be constructed to the highest commercial quality manufacturing standards and workmanship practices, consistent with commercial and design limitations which meet S-323-P-5A requirements as a minimum.

3.3.5 INTERCHANGEABILITY

All printed circuit boards, assemblies, modules, etc. shall be directly interchangeable with like units from the manufacturer. Equipment shall be designed to

facilitate replacement of units. Where possible, use shall be made of the same moudle, assembly, etc. in different parts of a subsystem.

3.3.6 SAFETY

The design and development of the equipment shall provide fail-safe features for safety or personnel during the installation, operation, maintenance, and repair of interchanging of a complete equipment assembly or component parts thereof.

3.3.6.1 Electrical Safety Provisions

1) The design shall incorporate methods to protect personnel from accidental contact with voltages in excess of 30 volts root mean square (rms) or direct current (dc) while operating equipment. Means shall be provided so that power may be cut off while installing, replacing, or interchanging a complete equipment, assembly, or part thereof.
2) Exposure to voltages in excess of 500 volts shall be prevented when cases and seals are removed for maintenance and repair. Equipment access doors or covers shall be provided with interlocks to remove all potential in excess of 150 volts.
3) Equipment shall be designed so that all external parts will be at ground potential. The path to ground for equipment shall be continuous and permanent when connected to facility and the interfacing equipment. Grounding shall be in accordance with SVS TBD Grounding Requirements Specification.
4) Equipment shall be fail-safe in regard to personnel safety, false command generation, and equipment damage during power transients, interruptions, and outages.

3.3.6.2 Mechanical Safety Provisions

The design of the equipment shall be such as to provide maximum convenience and safety to personnel while installing, operating and maintaining the equipment. Suitable protection shall be provided to prevent contact with moving mechanical parts such as gears, fans, and belts when the equipment is complete and operating. Sharp projections on cabinets, doors, and similar parts shall be avoided.

Equipment design shall include provision to prevent accidental pulling out of drawers or rack-mounted equipment components, or inadvertant tipping when pulling out drawers which could cause equipment damage and injury to personnel. Equipment power switches shall be designed and located that accidental contact by personnel will not place equipment in operation.

3.3.6.3 Temperature Conditions

Where people are involved, and under any condition of operation, exposed parts, including the enclosure of the equipment, shall not achieve a temperature in excess of 140°F at an ambient temperature of 77°F. The temperature of front panels and operating controls shall not exceed 100°F at the same ambient temperature.

3.3.6.4 Materials

The materials used in the CDPF operations, as well as that in the equipment, shall not create conditions or products which, when combined with the atmosphere or alone, are toxic, corrosive, flammable, or explosive and detrimental to the performance of the equipment or health and safety of personnel.

3.3.6.5 Chemical Safety

Equipment using chemicals in CDPF shall be designed to protect personnel, equipment, and the CDPF against leakage or accidental spillage during operation of

the facility. Where chemicals hazardous to personnel are used, appropriate warning signs shall be placed on the equipment and in the hazardous areas.

3.3.6.6 Laser Light

Where equipment, such as film recorders, use lasers for the generation of high intensity light beams, provision will be made by the use of interlocks, baffles and light traps as appropriate, for the prevention of exposure of personnel to laser light levels in excess of TBD.

In the event that it is necessary to operate equipment with the light beam exposed, the area surrounding the equipment shall be declared a hazardous area, and authorized personnel only shall be permitted access. Such personnel will be required to wear protective goggles at all times in the area.

3.3.7 HUMAN PERFORMANCE/HUMAN ENGINEERING

The equipment design shall incorporate human engineering principles and practices to insure that satisfactory performance can be achieved by the operating and maintenance personnel, that skill requirements and training time are minimized, and that the reliability of the personnel-equipment combination are at a maximum.

3.3.7.1 Equipment Configuration

CDPF equipment shall be designed to facilitate identification of subassemblies and to protect against improper mounting and installation.

Control panels shall be laid out to provide ease of operation andlabeled with titles of non-ambiguity with respect to function.

3.3.7.2 Adjustments

Design of all CDPF equipment shall consider human performance parameters in the adjustment methods used.

3.3.7.3 Visual Displays

Visual displays shall provide the operator with a clear and readable (to the granularity needed) indication of equipment or system conditions.

3.3.8 ELECTRICAL

3.3.8.1 Input Power and Regulation

Voltage:	115V ± 10% single phase 208V ± 10% 3-phase, 4-wire
Frequency:	60 Hz ± 2% Δf 1%/Min.

Note: 3-phase, 5-wire also available
Separate heavy isolated ground bus will be provided

3.3.8.2 Balancing of Loads

Equipment using 3-phase power in the CDPF shall present balanced loading of ±10% of nominal power per phase.

3.3.8.3 Utility Bus

Except for the Photographic Processing Elements, CDPF equipment shall not be operated from the utility power bus.

3.3.8.4 Grounding

Grounding of all CDPF equipment shall be as defined in SVS TBD.

3.3.8.5 Outlets

At least one convenience outlet shall be supplied on each CDPF equipment console.

3.3.8.6 Overload Protection

Fuses, circuit breakers, thermal overload relays, cutouts, etc. shall be used to provide overload protection for primary power circuits on each CDPF equipment.

3.3.8.7 Elapsed Time Indicators

An elapsed time indicator shall be provided on power operated equipment to indicate elapsed operating time.

3.3.8.8 Test Points

Units which are not completely self-checking shall be provided with appropriate test points, easily accessible, in standard crimp-on connector or test jack form. The test points provided shall be sufficient to isolate trouble in the equipment down to a removable subassembly.

SECTION 4

QUALITY ASSURANCE PROVISIONS

4.1 GENERAL

A Quality Assurance and Configuration Management Program shall be implemented in accordance with the requirements of NPC 200-3, GSFC S-323-P-5A, and GMI 8040.1 as defined in GE Document SVD TBD. The QA and CM Program Plan is subject to GSFC approval.

The requirements of Section 3 of this specification shall be verified by one or more of the following methods as specified herein.

4.1.1 INSPECTION

The inspection items identified in Section 4.2 shall be verified by an inspection of the equipment to the requirements as specified in applicable engineering drawings, standards, and specifications that result from the detailed design effort. Proper translation of these requirements into the drawings shall be verified through design review and routine design efforts. For those items which cannot be verified by inspection of the fully assembled items, this verification shall be accomplished at the appropriate lower level of assembly.

4.1.2 ANALYSIS

The analysis items identified in Section 4.2 shall be verified by analysis, as defined below:

1) Reliability - selective MTBF and MTTR analysis shall be conducted to identify potential weaknesses in the design.

4.1.3 DEMONSTRATIONS

The demonstration items identified in Section 4.2 shall be verified by demonstration. These demonstrations shall be continued until approval of performance as specified herein is received by NASA and GE. Nominally, it is intended that all

demonstrations will be satisfactorily completed in a scheduled three month simulation period at GSFC during which all initial maintenance shall also be accomplished.

4.1.4 TESTS

The test items identified in Section 4.2 shall be verified by tests as defined herein.

4.1.4.1 Component or Unit Level Tests

Component level tests shall be conducted to verify compliance with performance requirements established in lower level specifications.

4.1.4.2 Subsystem Level Tests

Subsystem level tests shall be conducted in accordance with GE-SSO and GSFC approved test plans and precedures to verify compliance with performance requirements established in subsystem level specifications.

4.1.4.3 Segment Tests

Compatibility testing and operational testing shall be conducted at the NDPF Segment Level in accordance with Segment Test plans and procedures prepared by GE-SSO and approved by GSFC. CDPF operational exercises shall be conducted to shakedown, debug and determine total CDPF operational performance under simulated mission conditions, including processing of known simulated spacecraft/payload data tapes. These known data inputs shall be compared with processed output data at the CDPF for data quality, resolution and accuracy.

Tests shall also be conducted on CDPF support services for data handling, storage and distribution. Throughput of the CDPF segment shall be exercised up to specified design requirements. These exercises shall also be used to validate all standard CDPF operational procedures for adequacy and accuracy.

4.2 VERIFICATION MATRIX

To Be Determined.

5.0 NOTES

5.1 ACRONYMS

The following table of acronyms is presented for the use of the reader not totally familiar with the EOS CDPF.

ACRONYM	TRANSLATION
ADP	Automatic Data Processing
ADF	Active Data File
BFET	Best Fit Ephemeris Tape
B&W	Black and White
CCT	Computer Compatible Tape
CDPF	Central Data Processing Facility
CTU	Computer Tape Unit
DCPT	Data Collection Platform Tape
DCS	Data Collection System
DCST	Data Collection System Tape
DME	Data Management Element
EDC	EROS Data Center
EMC	Electromagnetic Compatibility
EOS	Earth Observation Satellite
ERTS	Earth Resources Technology Satellite
GDHS	Ground Data Handling System
GSFC	Goddard Space Flight Center

ACRONYM	TRANSLATION
HDDT	High Density Digital Tape
HDDTR	High Density Digital Tape Recorder
ICD	Interface Control Document
IPE	Image Processing Element
LBR/LBIR	Laser Beam Image Recorder
MSS	Multispectral scanner
MTBF	Mean Time Between Failures
MTTR	Mean Time to Repair
NASA	National Aeronautics and Space Administration
NASCOM	NASA Communications
NOAA	National Oceanographic and Atmospheric Admin.
NTTF	NASA Tracking and Training Facility
OCC	Operations Control Center
ODG	Orbit Determination Group
OPS	Operations
PCM	Pulse Code Modulation
PFET	Predicted Fit Ephemeris Tape
P/L	Payload
RA	Random Access
RBV	Return Beam Vidicon

ACRONYM	TRANSLATION
R/M	Reliability/Maintenance
RMS	Root Mean Square
S/C	Spacecraft
SCPT	Station Contact Prediction Tape
TBD	To be Determined
TLM	Telemetry
TTY	Teletype
UTM	Universal Transverse Mercator
VTR	Video Tape Recorder
WX	Weather